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FACT SHEET

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BRUCELLOSIS

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Brucellosis is a highly communicable disease of animals and man caused by microorganisms of the genus *Brucella.* The disease is characterized in animals by abortion, retained placenta, uterine infection with impaired fertility and infection of the testicles in its principal animal host; in man, symptoms include chronic weakness, fatigue, malaise, fever, chills and generalized aches.

Cause

Six members of the *Brucella* genus affect specific species of animals: *B. abortus, B. suis, B. melitensis, B. ovis, B. neotomae,* and *B. canis.* There are no known *B. melitensis* infections in the the United States at present.

Bruacellae are intracellular organisms which are relatively unable to survive outside the infected host. They are killed by direct sunlight and drying. The organism may live and remain infective for several months in a cool, moist environment such as a cold, damp area in a shed or barn or in waste sewage. A general rule of thumb is that a premise is safe to restock if it has been free of animals for 30 days under dry conditions.

Host Animals

A wide range of animals is susceptible to both natural and experimental infection with *Brucella spp.* Many mammals, including ruminants, carnivores, swine and rodents, are naturally infected. Some wild animals and insects have been found infected with brucellae. There is some evidence that natural reservoirs of the organism may exist in some wild animals and insects. Epidemiological evidence indicates that brucellae have a definite host preference. For example, the primary hosts for *B. abortus* are cattle and bison. Other animals such as swine, sheep, deer, elk and coyotes can be infected with this organism, but they are secondary or "dead end" hosts, that is, they become infected but are incapable of serving as a major source of infection for cattle.

The coyote can become infected with *B. abortus* by feeding on infected materials, but this infection has not been reported to spread back to cattle under natural conditions. The coyote can be involved in the mechanical spread by dragging infected materials from one premise to another.

Brucella infections may be common in horses coexisting in brucellosis infected cattle herds. The disease in horses often appears as fistulous withers or pollevil when the organism localizes in these areas. Discharge from these abscesses can spread the organism back to cattle.

Method of Infection

Brucella organisms are highly invasive and capable of penetrating the mucous membranes of the mouth, nose, throat, conjuctiva and teat canal, as well as mammary tissue and normal or abraded skin. Brucellosis infection in domestic animals occurs primarily through the oral route by ingesting infectious materials. Since the pasteurization of milk and other dairy products has practically eliminated milk as a source of infection, the mode of infection in man is through penetration of the mucous membrane of the eye and upper respiratory tract or through normal or abraded skin.

In the natural course of the disease in domestic livestock, the invading organism gains entrance to the blood stream and lymph channels after which it becomes localized temporarily in the various lymph nodes of the body. The organisms become intracellular parasites and multiply within the phagocytic cells, eventually killing and disrupting the cell and releasing the organisms.

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Infection may not progress beyond the lymph nodes if the host's defense mechanism is adequate. In young, sexually immature animals, the disease is usually arrested in this stage and the organisms are gradually eliminated from the body. If the disease does progress, organisms enter the blood stream and are disseminated throughout the body. The outcome of exposure and infection will depend on many factors such as exposure dose, virulence of the organism, entry site, host resistance or stage of sexual maturity and/or stage of gestation.

Brucellosis is primarily a disease of sexually mature animals. In the sexually mature animal the organism disseminates throughout the body and localizes in the tissues. *B. abortus* prefers lymph nodes, the mammary gland, the pregnant uterus, testicles, accessory male sex glands and joint capsules. Congenital infection may occur in newborn calves as a result of infection from their infected dams. The infection may remain latent or hidden in a small percentage of the calves which will remain blood test negative until their first pregnancy and successful calving or abortion occurs. These blood test negative latent infections in animals are of some concern because they probably will go undiagnosed and can infect other animals.

The brucella organism are concentrated by the billions in the placental (afterbirth) and fetal fluids. They invade the wall of the uterus and eventually the placental attachments. The inflammation of the membranes interferes with normal fetal circulation, resulting in death and expulsion. Abortions usually occur after the fifth month of pregnancy. Not all infections result in abortions, and most cattle only abort once. During subsequent pregnancies they may have a full-term weak calf or a full-term normal calf. However, the dams may still be infectious and capable of spreading the disease. Uterine infections normally disappear within a month of calving, but they are likely to become reinfected during subsequent pregnancies.

Incubation Period

The incubation period for brucellosis is the time period from exposure to the organism until the animal has a significant serological response or the disease, whichever occurs first. In cattle, the incubation period can vary from 10 to 285 days. Most animals develop a positive blood test reaction within 90 to 120 days and frequently less than 60 days. Vaccinated animals not fully protected usually have an incubation period of 30 to 45 days longer than those not vaccinated if they contract brucellosis.

Many factors may influence the incubation period. There is an inverse relationship between the size of the exposure dose and the length of the incubation period. The smaller the dose, the longer the incubation period. Also, natural resistance varies greatly among individual animals. Young, sexually immature animals are relatively resistant to infection. The pregnancey status and stage of gestation are important factors and animals in their first gestation appear to be the most suspectible. The incubation period is generally inversely proportional to the stage of pregnancy. Animals exposed at or near conception have a longer incubation period than those exposed later in gestation. Those exposed later in the gestation period have an incubation period of about 45 to 60 days.

Transmission

Once an animal becomes infected with brucellae they usually are considered infected for life. There is an intricate balance between the host and the parasite. The parasite is largely protected from the normal host defenses because the organism localizes and multiplies within the cells. There is usually a minimal disturbance in the host animal except during certain periods of reproduction. Because of the intracellular nature of the organism and the limited areas of localization there are extreme limitations on how the organism is shed.

Brucellosis in domecstic livestock is primarily a disease of the reproductive tract. *B. abortus* has its greatest concentration in the udder, pregnant uterus, the fetus and the placental membranes. These organs are considered to be the major source of infection. The organisms are shed in the milk of the infected animal, but this is not the most important means of spread from animal to animal. The brucella organisms escape from the infected animal in the fetal membranes and in the vaginal discharges for a few days before calving and for 3 to 4 weeks after calving. In rare cases an animal will harbor the organism in the uterine mucosa and shed it from the uterus for months. Billions of organisms are shed in these fluids and membranes at calving. The most common method of contracting infection in domestic animals is through the ingestion of infectious material. Penetration of the intact skin and conjunctiva of the eye and contamination of the udder during milking are secondary modes of entry.

Cattle are frequently exposed by licking or muzzling an aborted fetus, a newborn calf or the external genitalia of infected cows shortly before or after calving. Feed and water contaminated by uterine discharge or other infectious material is an important method of spread. The infective dose of the brucella organisms is probably around 10,000 bacteria. Therefore, because of the dilution factor and method of dissemination in streams and ponds, surface water is not considered to be a major source of infection. Watersheds and ponds may play an active part in the spread of the disease because they

are ideal places for congregation of cattle and thus a mixing of herds, over-the-fence contamination or mechanical spread by wild carnivores (coyotes, fox, etc.). These congregating areas are also very important in the intraherd transmission of the disease because there will likely be a higher concentration of animals in this location when an infected animal aborts and sheds the organism. Grazing contaminated pasture or other feed sources within these concentrated areas is a common source of infection. A bovine that aborts and sheds these organisms in an isolated area is seldom a major agent in the spread of this disease. If the infectious material is exposed to direct sunlight and drying, the brucella will die within 6 to 12 hours. Conversely, the organism will survive for months in a cold (freezing or near freezing), dark, damp environment.

Herd size can be an important factor in spreading brucellosis because there is a higher probability of introducing infection into the herd. However, even more important than herd size is herd density. Highly concentrated groups of animals increase the likelihood of increased animal-to-animal contact.

Infected bulls do not usually transmit brucella organisms to non-infected cows by natural service. *B. abortus* produces an acute inflammation of the testicles which results in severe pain with reduced libido and impaired fertility. However, the chance of spread is quite high when infected semen is used for artificial insemination. Some bulls will have negative blood titers, but still shed the organism in the semen.

Signs of Disease

Abortion is the chief characteristic of the disease in cattle. Most cows will abort when infected with *B. abortus* the first time, usually after the fifth month of pregnancy. In subsequent pregnancies, the fetus will frequently be carried to term, but abortions will continue in some cows. The calves born at full-term from infected dams may be weak, but often they are normal. Even when the calf is normal, the dam usually sheds the brucella organism. Abortion "storms" may occur when a large group of animals are exposed to brucellosis for the first time during the breeding season. These "storms" may be followed by years of relatively low incidence of abortions because of developed immunity.

Retained placentas and subsequent metritis (uterine inflammation) are common conditions following abortion. The placenta may be retained for a few days to two weeks. The metritis may be acute or chronic. Occasionally cows will develop a septicemia and sudden death, but more often the infection will be chronic and lead to sterility or at least decreased fertility.

Udder infections are usually non-clinical. However, the organism will be shed in rather high concentrations at calving. A rather high percentage of cows have a permanent udder infection characterized by periodic shedding of organisms.

The brucella organism will frequently invade the joints causing inflammation and lameness. Swellings may be found in joint areas, especially of the knee.

Diagnosis

Diagnosing brucellosis is difficult and depends upon many factors. In making a diagnosis, one must consider herd history, clinical signs, serological examination of the blood or milk and isolation of the causative agent. Herd history is extremely important in the diagnosis of any disease, especially that of brucellosis diagnosis. The animal's age, incubation period, previous herd infection rate, possible exposure, type exposure, vaccination status and individual variations are all important considerations in diagnosing brucellosis. One should know the vaccination date before conducting a serologic test. A lengthy or erratic incubation period and potential latent infections are other critical factors.

Blood tests are practical and useful in diagnosing brucellosis. These tests are not 100 percent accurate, but they have a high degree of accuracy when used as a series of tests and in combination with other diagnostic tools. Positive blood test results represent past exposure to an antigen or organism and cannot always be equated with infection. Because of the chronic nature of brucellosis, however, the presence of high levels of circulating antibody usually indicates infection. Occasionally, vaccination antibody levels will remain relatively high and these can be confused with infection antibodies. Some of the supplemental tests have partially eliminated this problem. In some isolated incidences there is a cross reaction with similar bacteria such as *Yersinia enterocolitica* or some strains of *E. coli* and salmonella. Fortunately these are rare. Research is being conducted to find a test with greater accuracy to prevent the unnecessary slaughter of uninfected "reactor" animals and to more accurately detect infected cows. However, the present blood test diagnosis in cattle is quite reliable when used with herd history and epidemologic evaluation.

The major serological tests now available are the tube agglutination, plate agglutination, buffered brucella antigen card (Rose Bengal) test, rivanol, complement fixation, Coomb's antiglobulin and hemagglutination test. Other tests include the milk individual ring and whey test, vaginal mucous and semen plasma agglutination and fluorescent antibody examination on tissues or excretions.

The most common test presently used is the buffered brucella antigen or card test. This test is simple and can be performed on the farm or ranch, at the market facility or in the laboratory. The test is a

good screening test although it may be overly sensitive and there may be an excess of false positives and false negatives, especially in vaccinated populations; therefore, the test should be confirmed by additional tests.

The rivanol test depends upon precipitation of the high molecular weight agglutinins (IgM) by an aniline dye. This test is less sensitive than the card test and is simpler to perform than the complement fixation test.

The complement fixation test is currently considered by some to be the best overall diagnostic test for brucellosis; however, it has two disadvantages. First, it is a more complicated laboratory test that cannot be performed in the field. Second, it is more specific, but less sensitive than other tests and there are more false negative reactions. However, the test is still a superior test, particularly in chronic infections and in vaccinated cattle.

A newer test called the ELISA test has much promise and may combine the best of all the above qualities; however, experimental and field data are needed to prove its value.

The milk ring test is basically an agglutination test conducted in which the agglutinins are associated with the fat globules; these combine with a dyed brucella antigen and rise with the cream.

In general, the serologic tests have some limitations. First, these tests detect some nonspecific antibodies and some vaccination antibodies as well as specific *B. abortus* antibodies. Second, these tests are slow to detect antibodies during often prolonged incubation periods. Third, during chronic infections the antibody levels begin to wane and may become undetectable by current test.

The only unequivocal means of diagnosing brucellosis is by isolation and identification of the causative organism. The milk or udder secretions are an excellent source of the infective organism in live specimens. The supramammary lymph nodes are the best tissues to examine from mature cattle during postmortem examination. The brucella organisms are found in abundance in the stomach and lungs of an aborted or infected fetus as well as the placenta. The outer surface of the thickened chorion of the placenta is the best source of bacteria. Observation of the brucella on direct slide mounting and staining plus culture and typing is usually sufficient for a trained diagnostician to make a positive diagnosis.

Prevention and Control

Prevention and control of brucellosis can succeed when there is an adequate herd health plan properly implemented and closely followed. Any herd health plan designed to control this disease must include diagnosis, sanitation and hygiene, elimination of infections, preventing establishment or re-establishment of disease and inducing protective immunity.

Following diagnosis of brucellosis in a herd, all reactor animals must be eliminated. Treatment of disease is impractical and probably not effective. Diseased animals usually remain carriers of the disease for the remainder of their lives; therefore, all reactors must be sent to slaughter.

Preventing establishment or re-establishment of disease entails improved management practices, including an effective immunization program and prevention of the reintroduction of disease.

Bovine brucellosis may be reduced with an effective vaccination program. However, the disease cannot be eradicated without the total elimination of all infected carriers. Strain 19 vaccination will reduce the incidence of abortion drastically, but will not eliminate all infection. *B. abortus* Strain 19 vaccine has been a most effective tool in brucellosis control. Strain 19 is a low virulence strain which has never been shown to spread from vaccinated to susceptible cattle, and it has not been shown to revert to the virulent form. Strain 19 is incapable of causing abortion except possibly in cows vaccinated late in pregnancy. The vaccine strain is a live organism which can cause infection in man; occasionally, a vaccinated calf will remain infected with the vaccine strain and will shed the organism in the milk when she becomes an adult. The vaccine is very effective in protecting uninfected or nonincubating animals in a brucella contaminated environment.

The ideal age for vaccination is between 4 and 8 months. Official regulations allow for a vaccination age range of from 4 to 12 months. The advantage of early calfhood vaccination is that serum antibodies recede at an earlier age, helping prevent vaccinal card test positives. The closer a calf is to sexual maturity, the greater the possibility of prolonged serum antibodies which can complicate diagnostic tests. Some states have approved the use of a reduced dose vaccine which is very beneficial in reducing the post-vaccinal titers. The full dose vaccine contains approximately 90 billion organisms in a 5.0 cc dose, whereas the reduced dose vaccine has approximately 1.0 to 3.0 billion organisms. The smaller dosage has been shown experimentally to be nearly as effective as the full dose with the advantage of reducing prolonged titers.

Adult (females over 12 months of age) vaccination with reduced dose vaccine has been very effective in slowing the spread of disease as well as reducing or preventing abortions. Since adult vaccination helps in the early detection and removal of cows that are in the incubating stages before they have an opportunity to spread the disease, it may be a useful tool in heavily infected herds.

No vaccine is 100 percent effective in preventing infection. Research indicates that 65 to 70 percent of the animals vaccinated with Strain 19 vaccine have an adequate immunity against a standardized

challenge with field strain organisms. Field experience indicates that in the fully vaccinated herd immunity may exceed 90 percent.

Vaccination of bulls is not recommended or practiced since reports indicate it may result in testicle infection and shedding of *B. abortus* Strain 19 in the semen.

The three main disadvantages of Strain 19 vaccine are: infective for man; failure to completely prevent infection, especially of the udder; and the persistent post-vaccinal titer which complicates diagnosis. The use of a reduced dosage vaccine has decreased the post-vaccinal titer problem.

There are several general managment considerations for preventing establishment and spread of this infection in cattle.

- Raise replacement animals and vaccinate all females between 4 to 12 months of age.
- If buying replacements, buy only vaccinated cattle from certified free herds.
- Isolate and retest all new cattle over 15 months of age within 45 to 120 days.
- Separate "springer" cows from the remaining herd. Watch for any premature births or abortions.
- Have all aborted or weak calves checked by a veterinarian and a diagnostic laboratory to determine cause.
- Keep fences in good repair. Do not mingle cattle with neighbor's livestock.
- Observe cattle in congregating areas for aborted fetuses or abnormal discharges so animals can be isolated.

Human Brucellosis

Brucellosis in humans is called undulant fever and manifestations of the disease include weakness, fatigue, malaise, fever, chills and sweats. The symptoms may occur for a few days, subside and then recur. Patients with undulant fever usually complain of body aches (especially the joints), headaches and anorexia. They often experience nervousness, insomnia, mental depression, dizziness, neurotic pain, back and neck pains nausea and vomiting. Testicular swelling and pain in the male may occur.

The condition varies in severity from a mild infection which lasts only a few days to an occasional fatality. The mortality rate is reported to be less than two percent; however, those who recover may develop chronic brucellosis with occasional severe complications.

Undulant fever is primarily an occupational hazard for packing house workers, livestock producers and veterinarians. It is also a problem in persons who consume milk, cheese or other milk by-products from unpasteurized sources. Between 1967 and 1978, over one-half the reported cases occurred in people associated with the meat processing industry. Livestock producers make up the majority of the remaining cases. In recent years, there has been an increase in brucellosis in people who have consumed unpasteurized dairy products, including milk and cheese. Estimates in California indicate that 95 percent of human brucellosis occurred as a result of the consumption of unpasteurized dairy products from Mexico. In 1976 in the United States, human brucellosis occurrences by occupation were: packing house employees (54 percent), livestock producers (11 percent), veterinarians and meat inspectors (9 percent) and other miscellaneous categories (18 percent).

Since 1970, cases of human brucellosis in the United States have ranged from 175 to 328 per year, with 328 cases in 1975 and 271 in 1976. An estimated 176 cases were reported in 1981. There were 6,321 human cases of brucellosis reported in 1947.

Human brucellosis is a reportable disease in every state except Nevada. It is estimated that only about 10 to 15 percent of the human cases of brucellosis are ever diagnosed or reported. There has been a steady decline in human brucellosis which parallels the decline in cattle brucellosis.

Government Regulations

The Federal Government has authority to control interstate shipment of livestock and to place certain restrictions upon movement to control the spread of disease. The Code of Federal Regulation (CFR), or the rules for interstate shipment of livestock, must be published and approved after adequate time for comment and hearings by the Office of the Federal Register. In the United States the authority to carry out the regulations has been given to the United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS). This agency has established a set of minimum standards called the Brucellosis Eradication Uniform Methods and Rules (UM&R), for achieving and maintaining certified herds and classified free area status after careful consideration of the recommendations by the United States Animal Health Association.

Each of the individual states formulates its own rules in addition to the UM&R and CFR. Therefore, to transport animals from one state to another, shippers must meet the requirements of the state of destination as well as the CFR's.

Most regulatory programs which are designed to prevent or control and eventually eradicate brucellosis, attempt to (1) locate the infection; (2) contain the disease; (3) eliminate infected animals, and (4) prevent reinfection. The four cornerstones of the Texas brucellosis program are vaccination, surveillance, laboratory support and individual herd plans leading to certified brucellosis-free herds.

Infection can be located by surveillance through

testing programs conducted on the ranch, at livestock markets or slaughtering plants. The disclosure of a reactor animal is followed by testing all contact animals from the herd of origin initially and later from adjacent herds if thought necessary. Proper animal identification and records are essential ingredients of this program to trace back reactors to herds of origin.

Containing the disease requires quarantining exposed herds to restrict movement from affected premises. A herd must be proven free of disease and current exposure before animals can be placed back into trade channels. Blood testing is the most satisfactory method of determining herd status at the present time. All infected animals must be isolated and eliminated from the herd by slaughter.

Vaccination and purchasing brucellosis-free animals are the most effective ways to prevent reinfection.

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